Latest results and future activities at Risø DTU within trailing edge flaps

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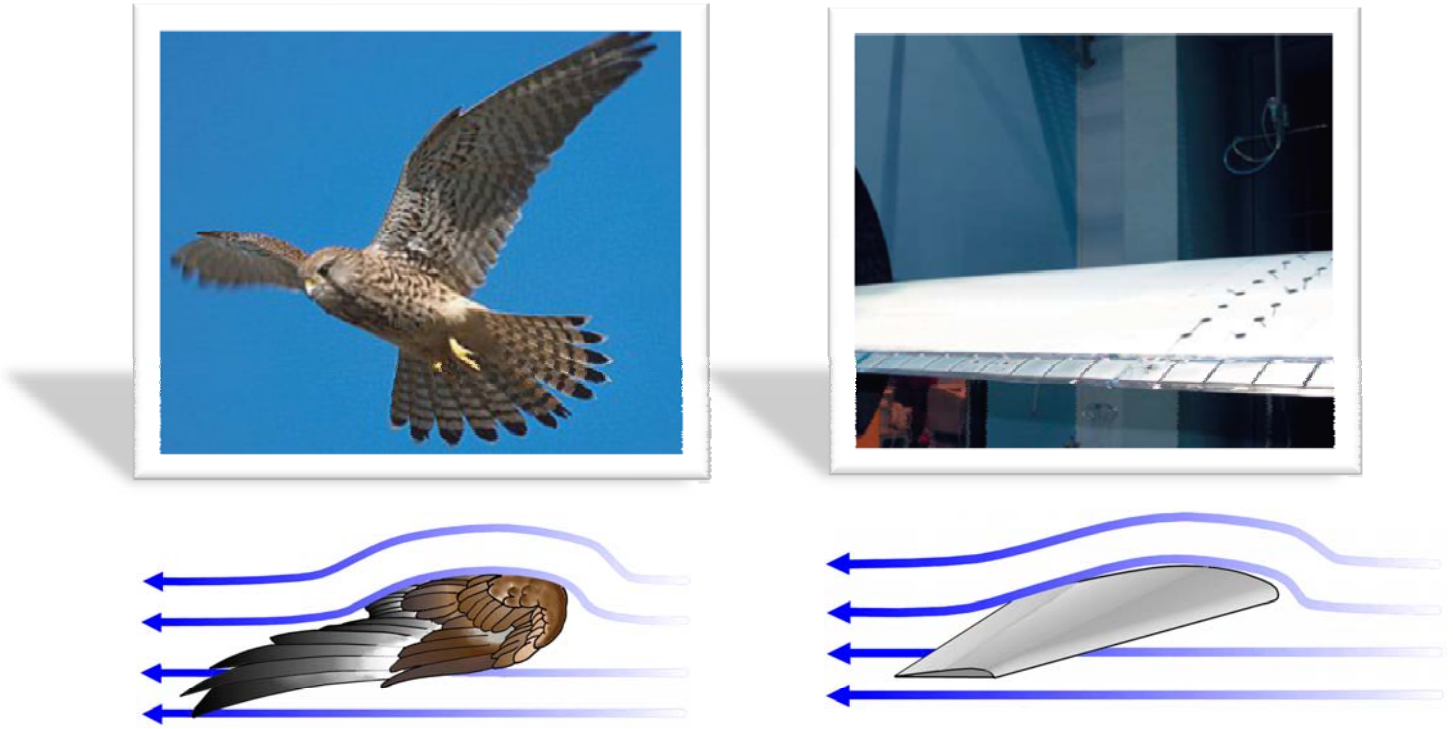

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Frederik Zahle, Joachim Heinz, Leonardo Bergami, Li Na, Andreas Fisher

Activities on trailing edge flap at Risø DTU:

- Stability
- CFD
- New Concepts (rubber/piezo)
- Advanced controls
- Wind tunnel test
- Full scale tests
- Sensor design

Introduction (1:2)

Sensors and DTEG positions

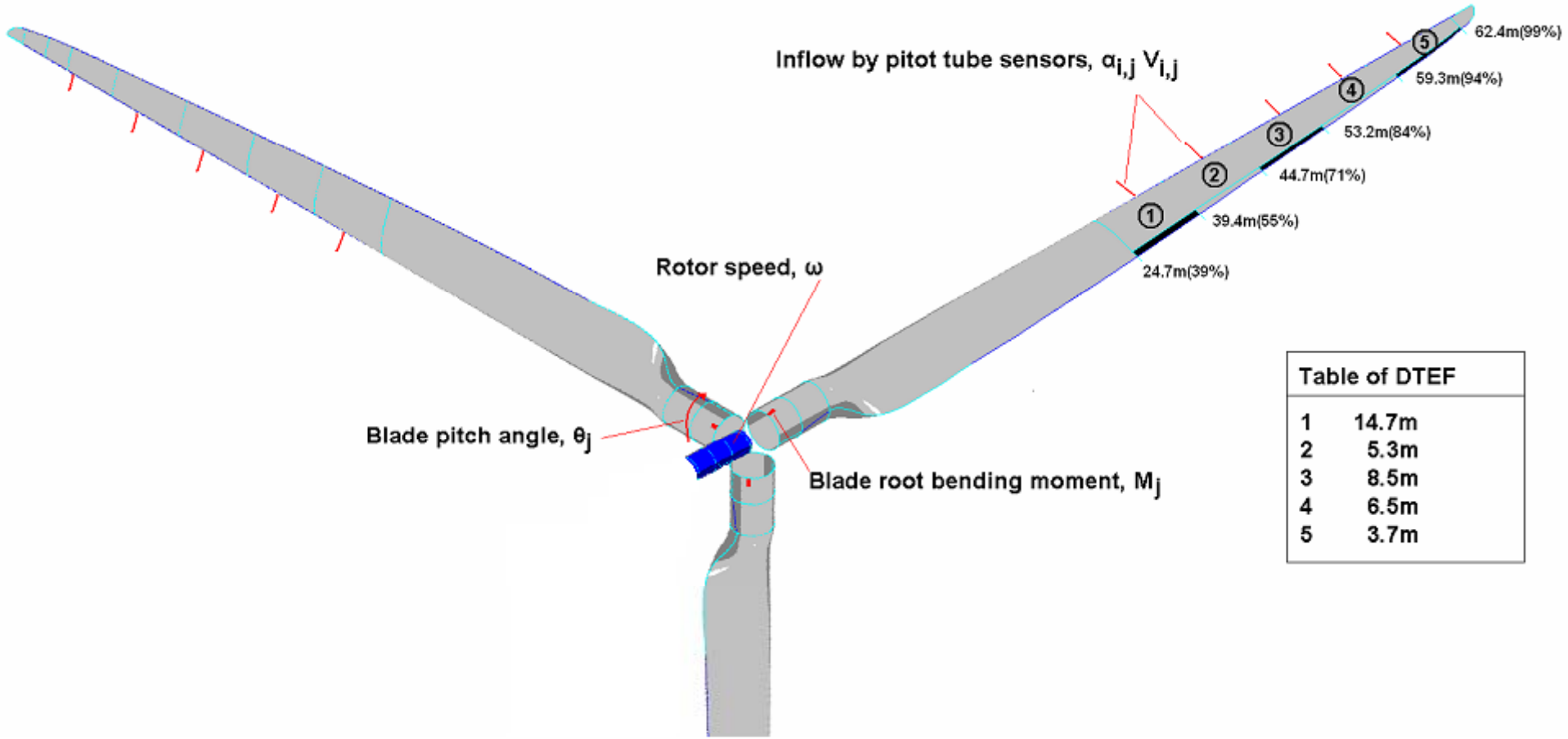

Table of DTEF	
1	14.7m
2	5.3m
3	8.5m
4	6.5m
5	3.7m

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Introduction (2:2)

DTEG Property assumptions:

10% of chord

+/- 8 degree deflection possible

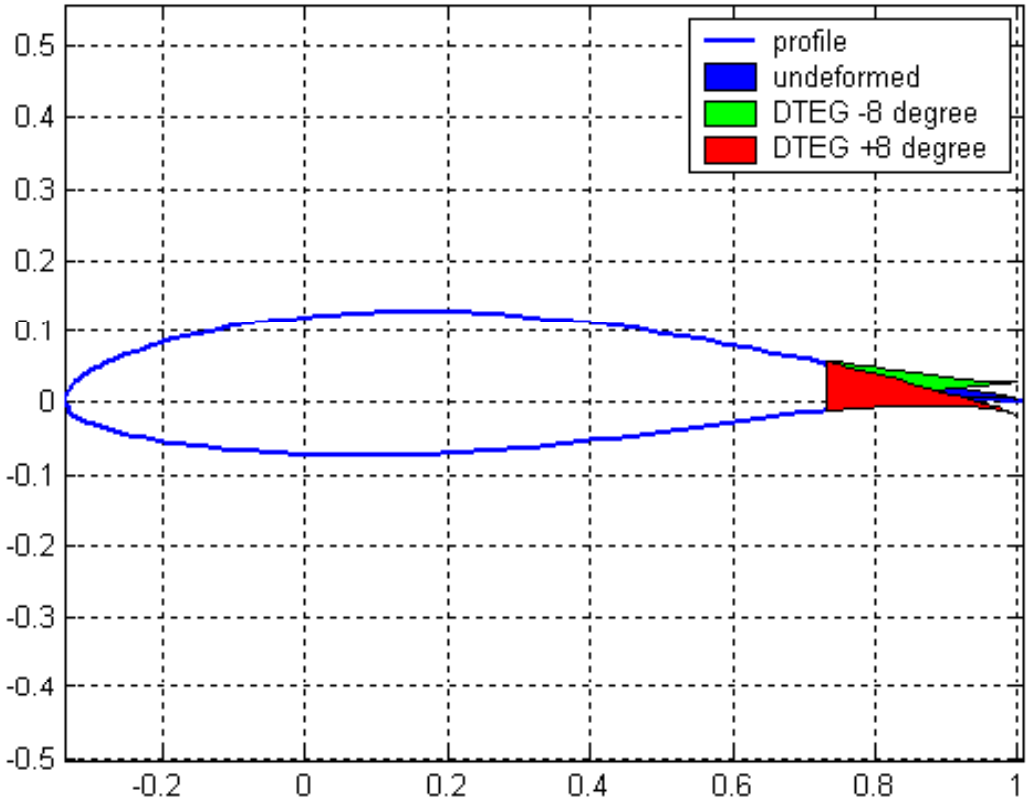
from +/-8 to -/+8 in simulated “dt” (=0.01s)

no effects of hysteresis

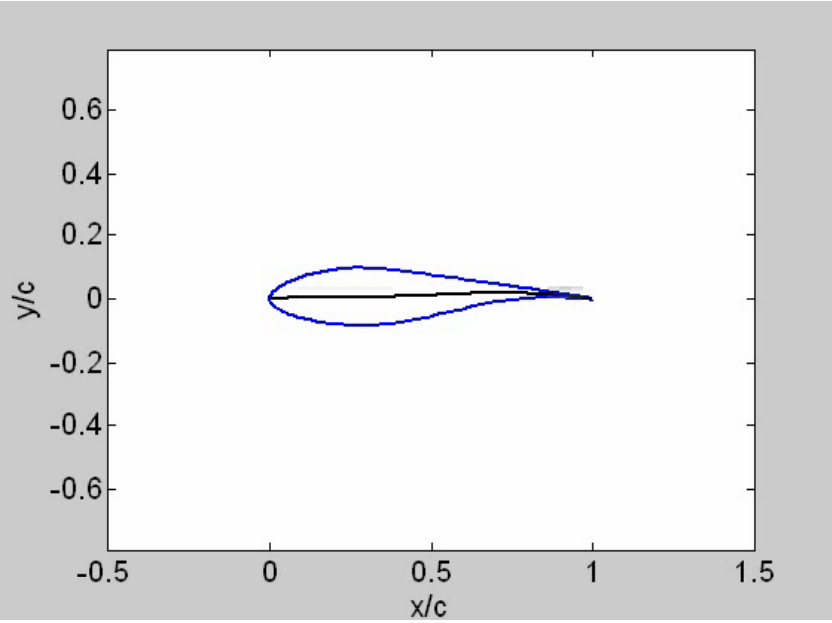
no overshoot or other dynamics

max ΔCL(α,β=8deg) = 0.29

min ΔCL(α,β=-8deg) = -0.29

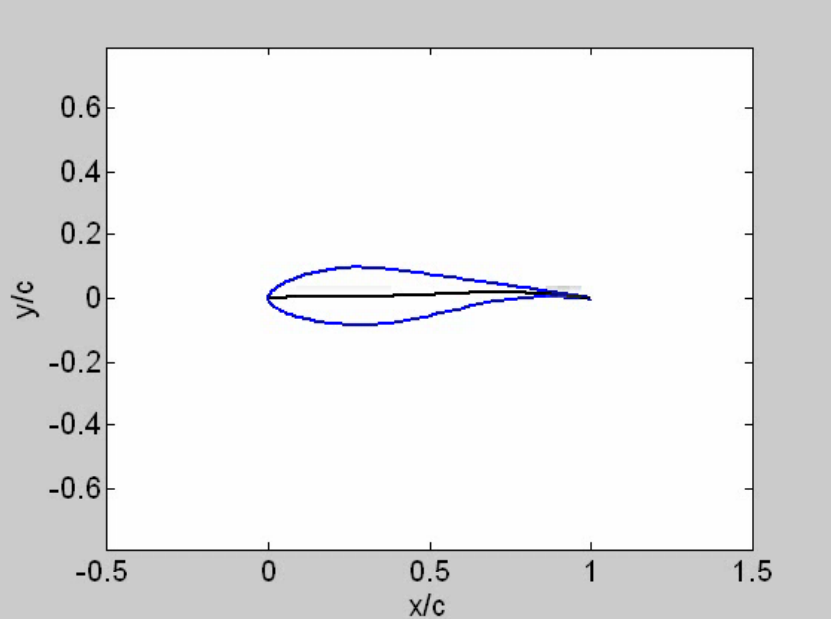


Classical flutter



142 m/s

"Control flutter"



90 m/s

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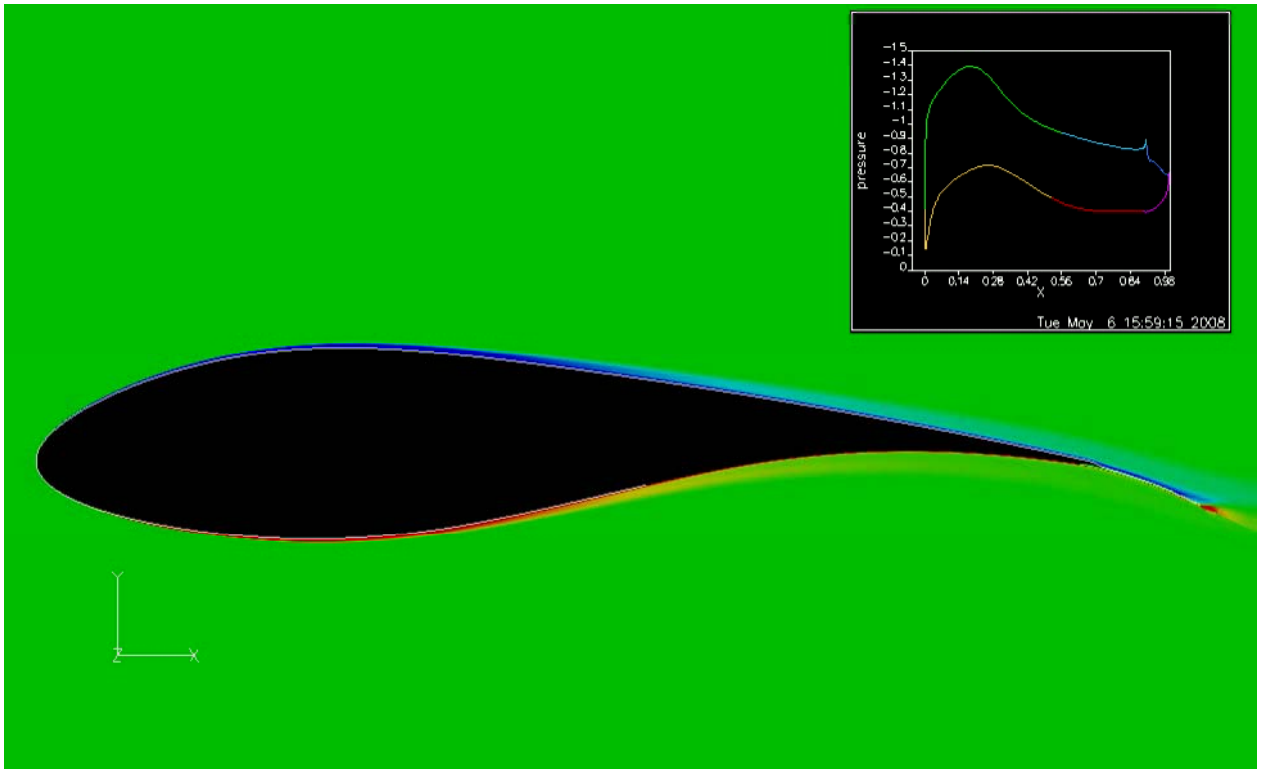
CFD



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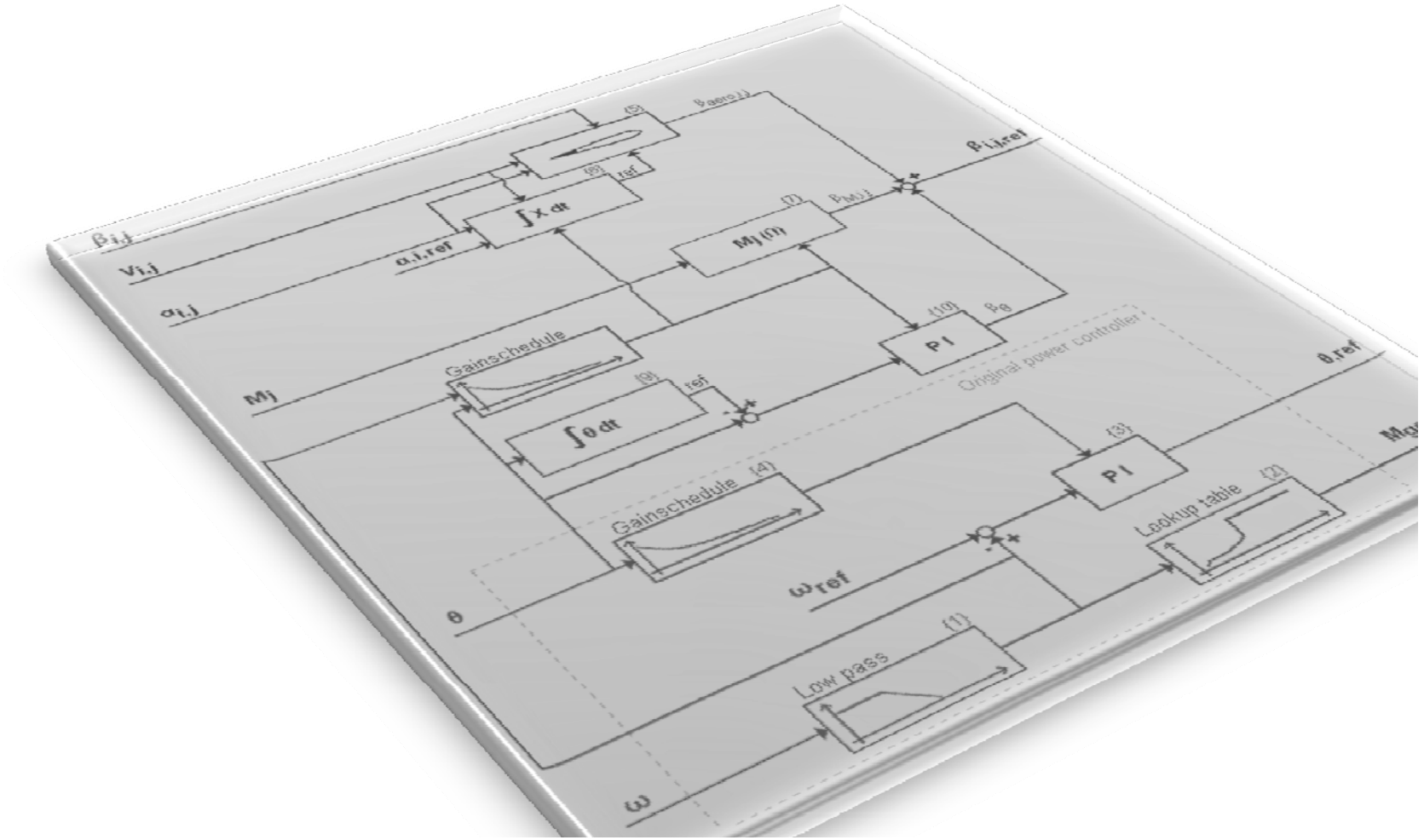
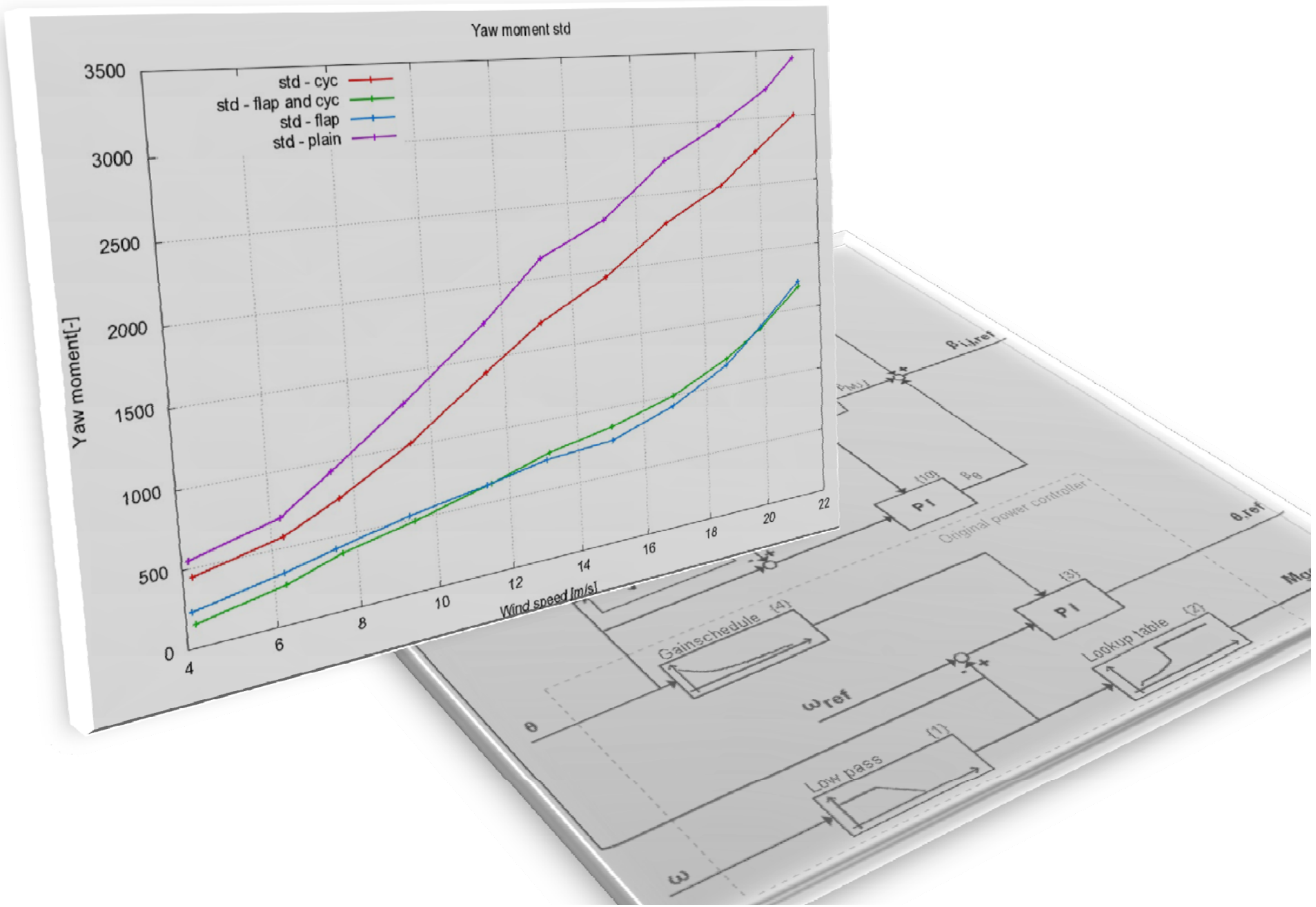
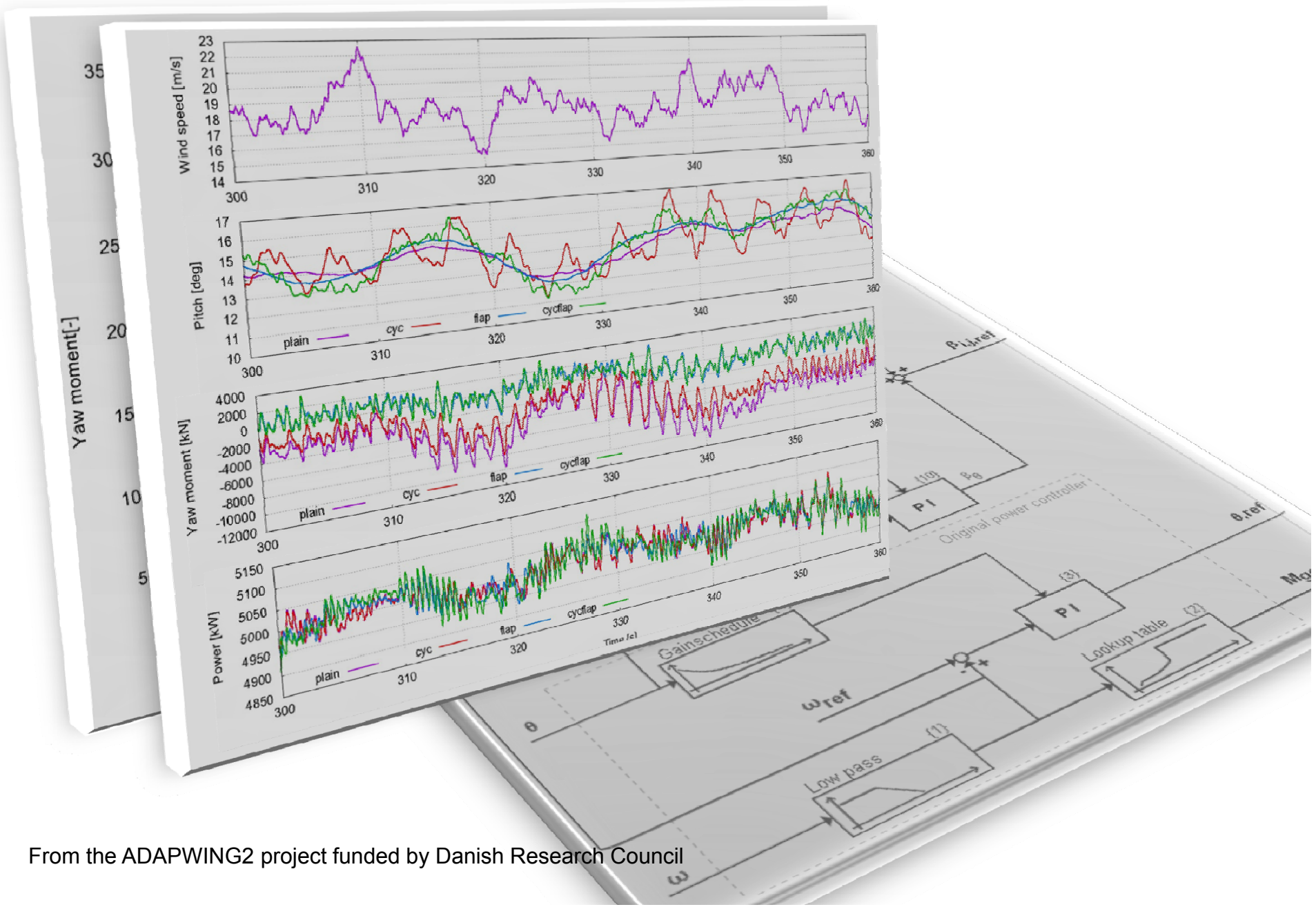
Advanced Controllers



Advanced Controllers



Advanced Controllers



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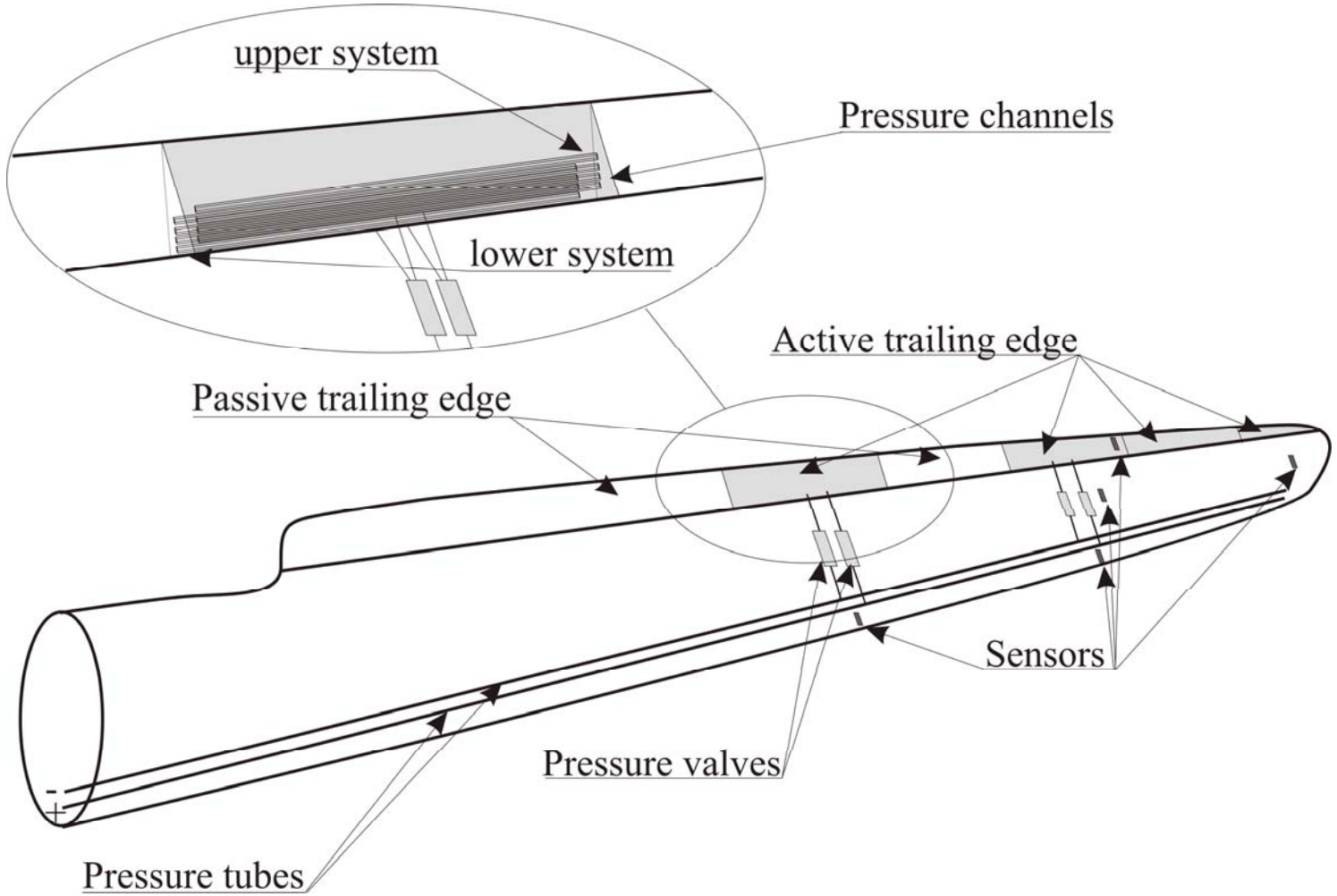
New concepts



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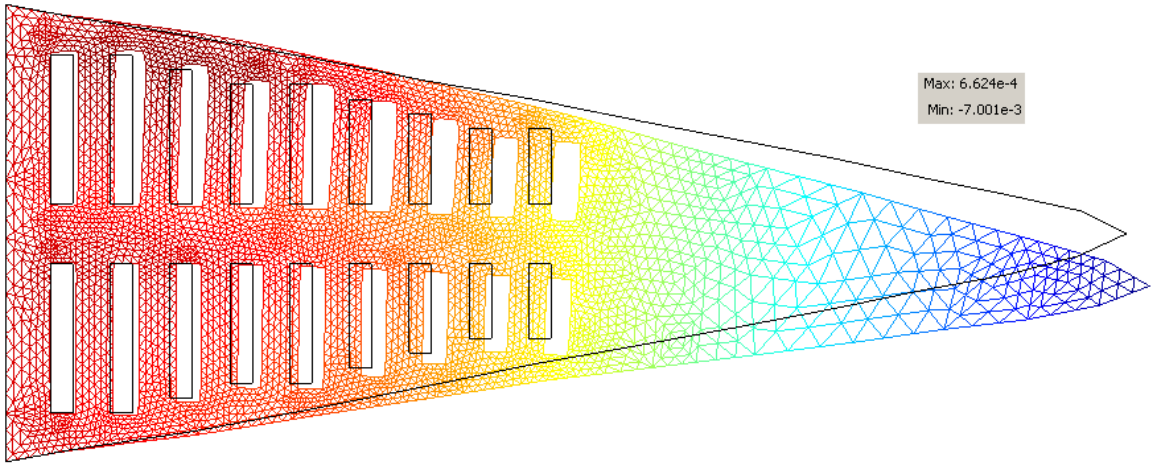
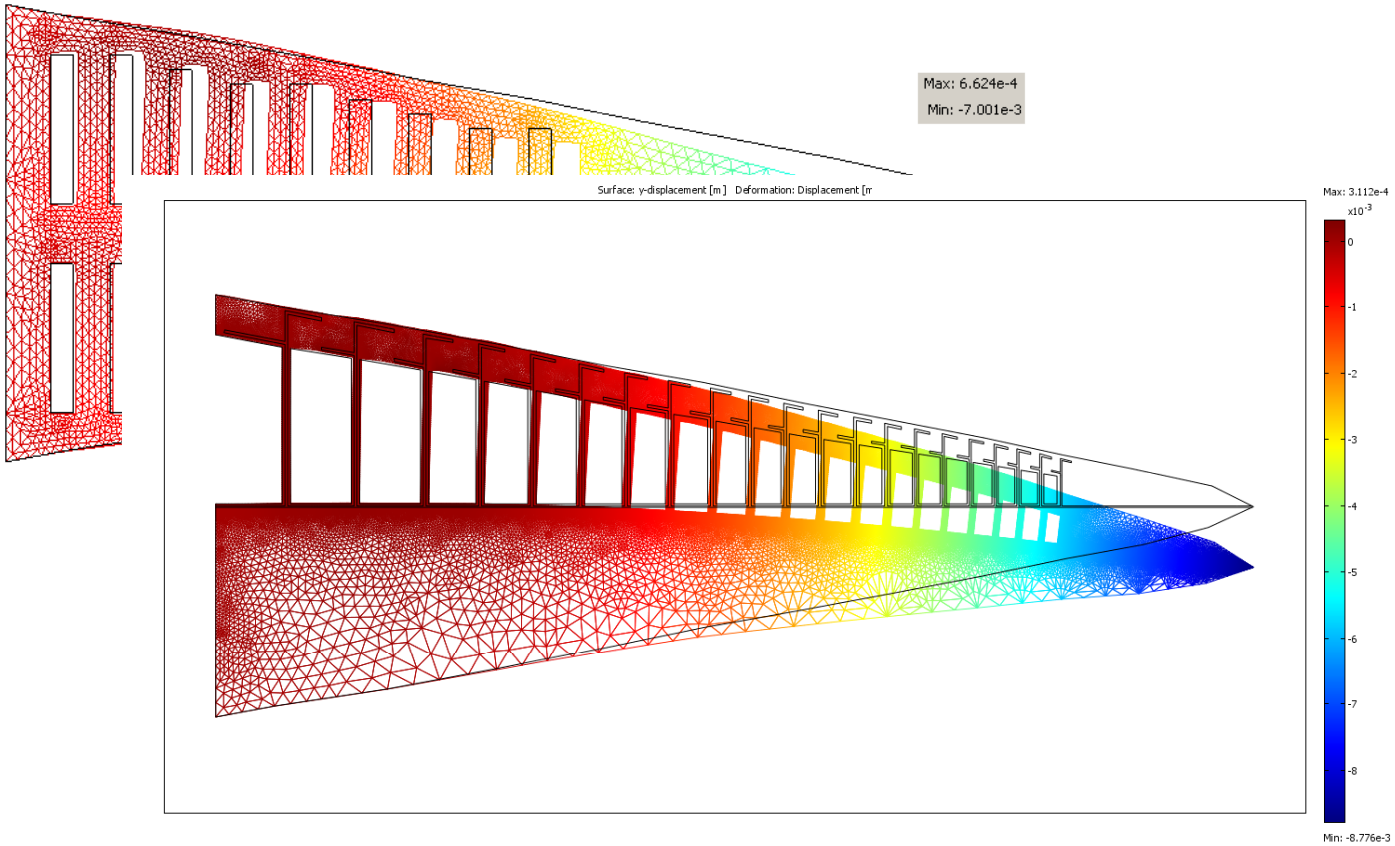
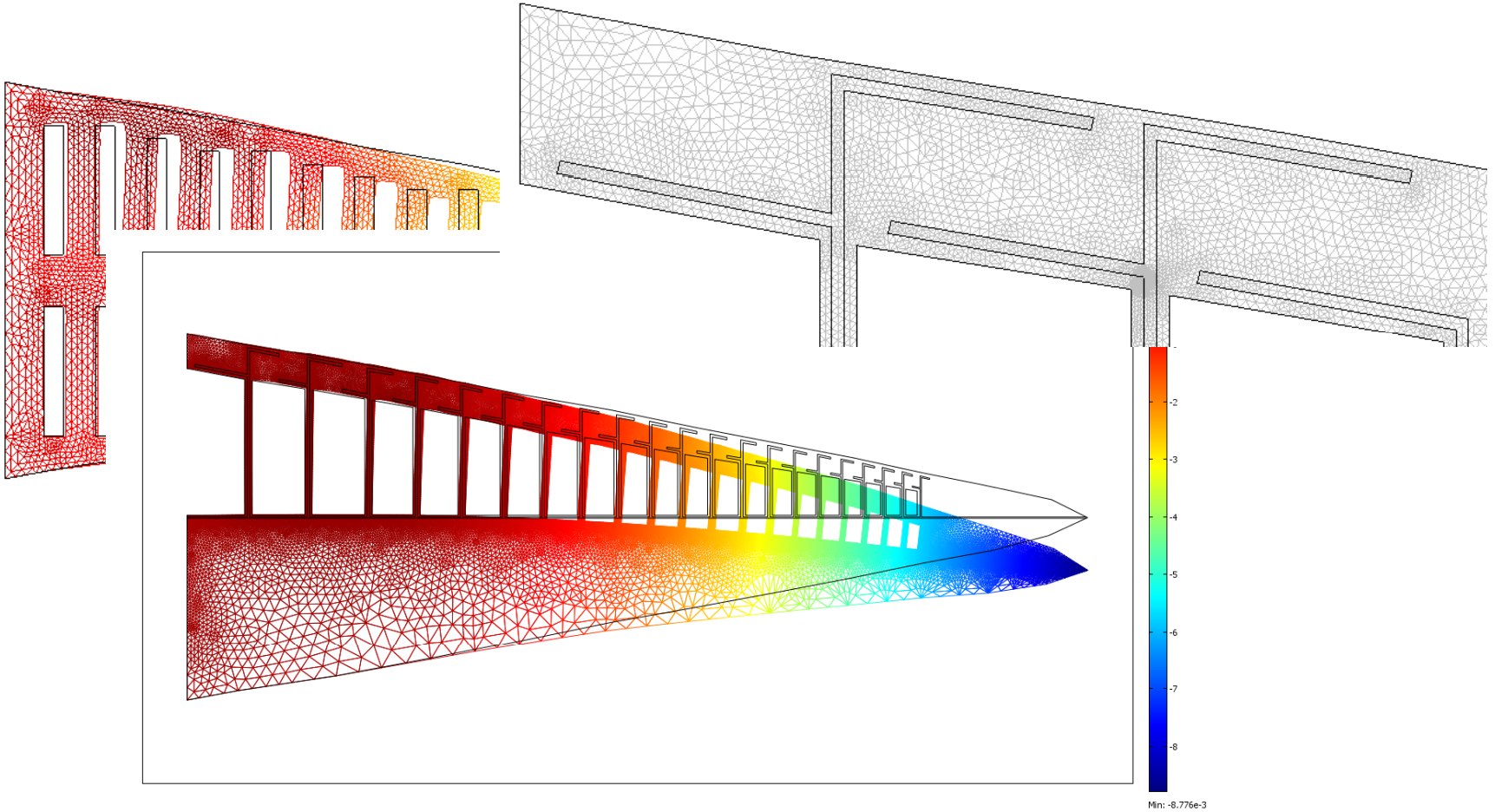
New concepts



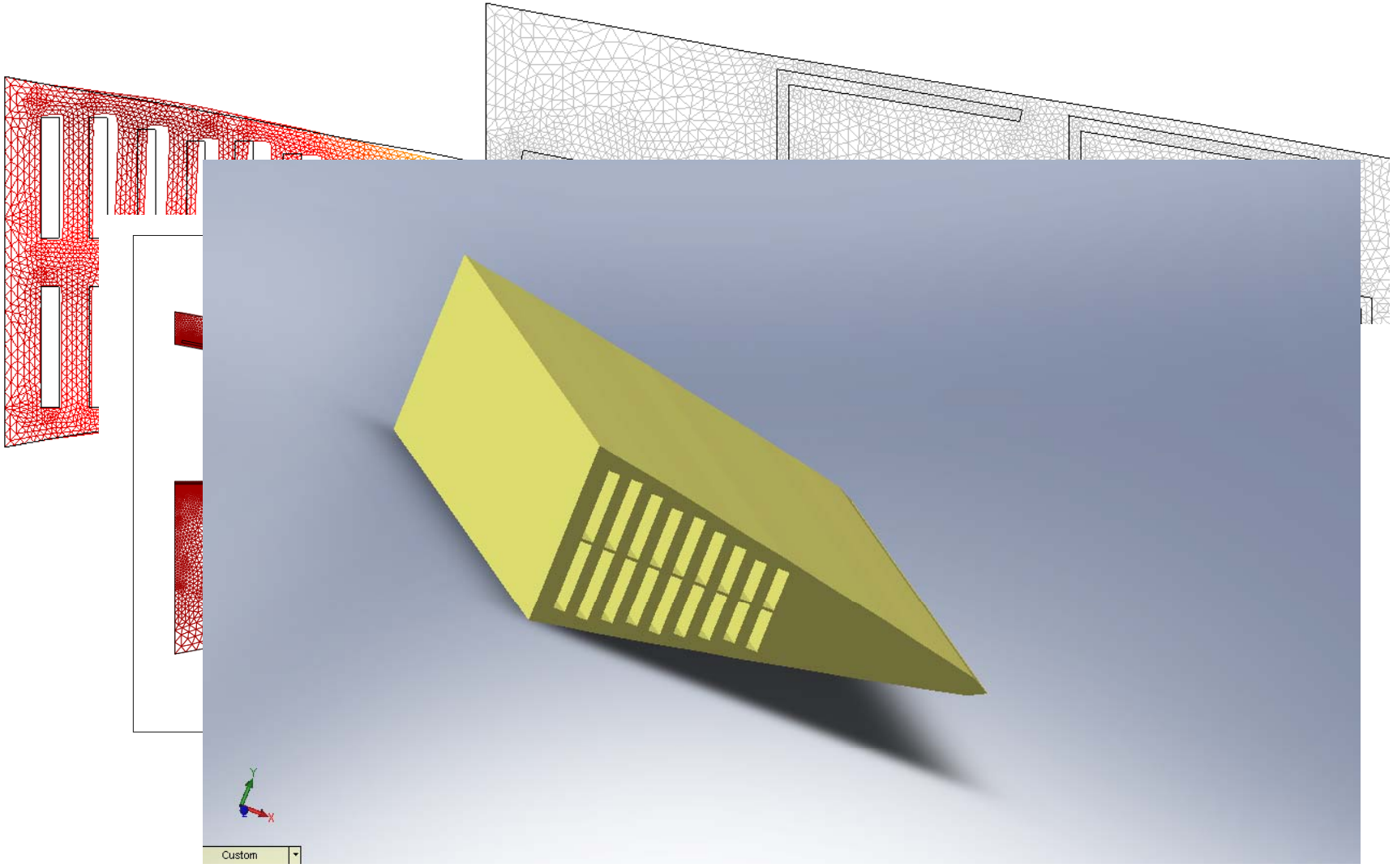
New concepts



New concepts



New concepts



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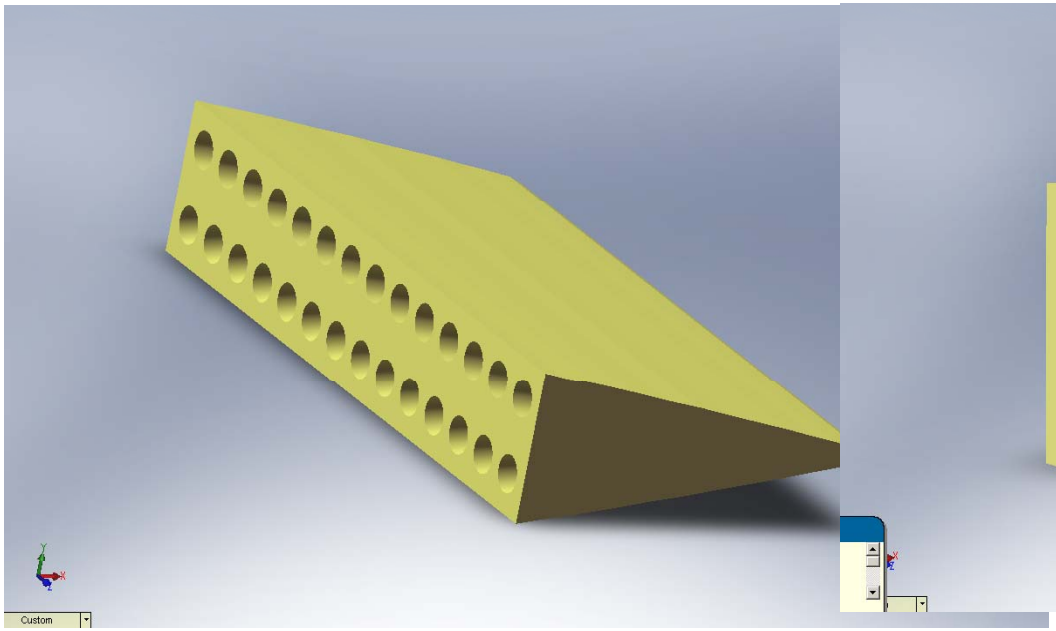
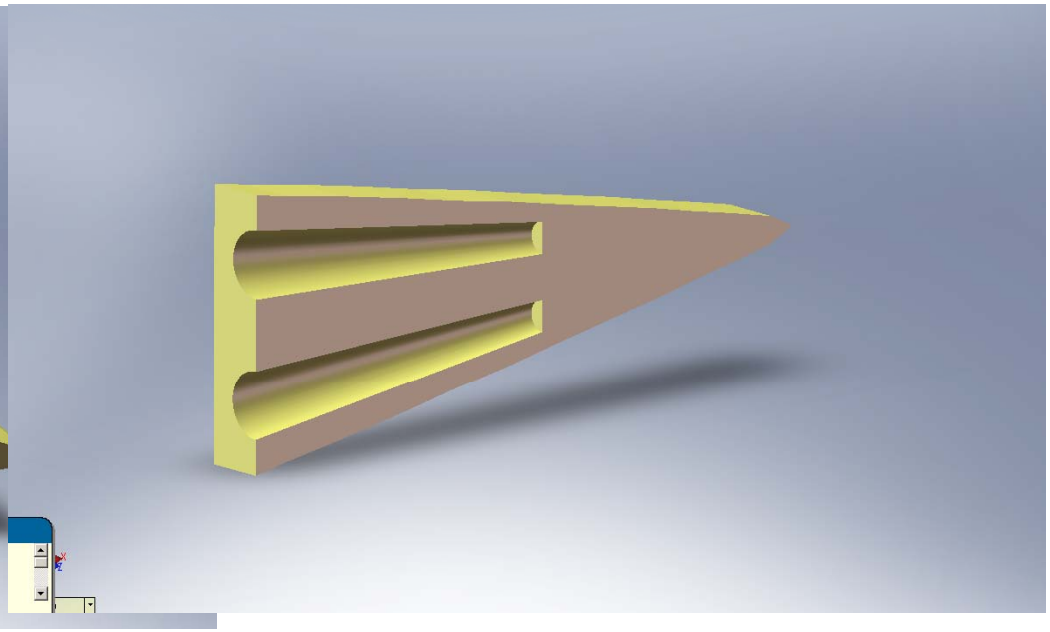
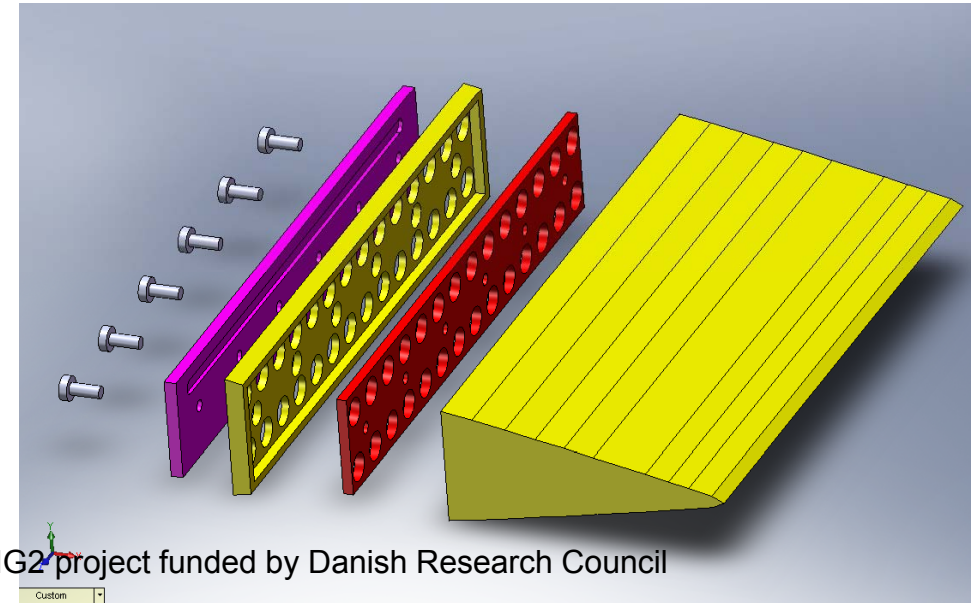
New concepts







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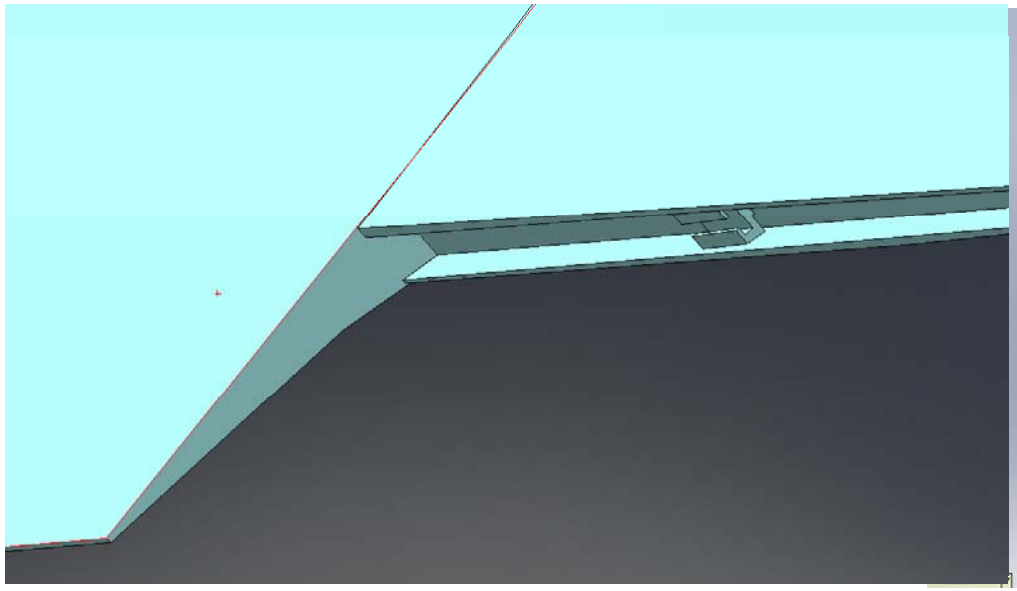
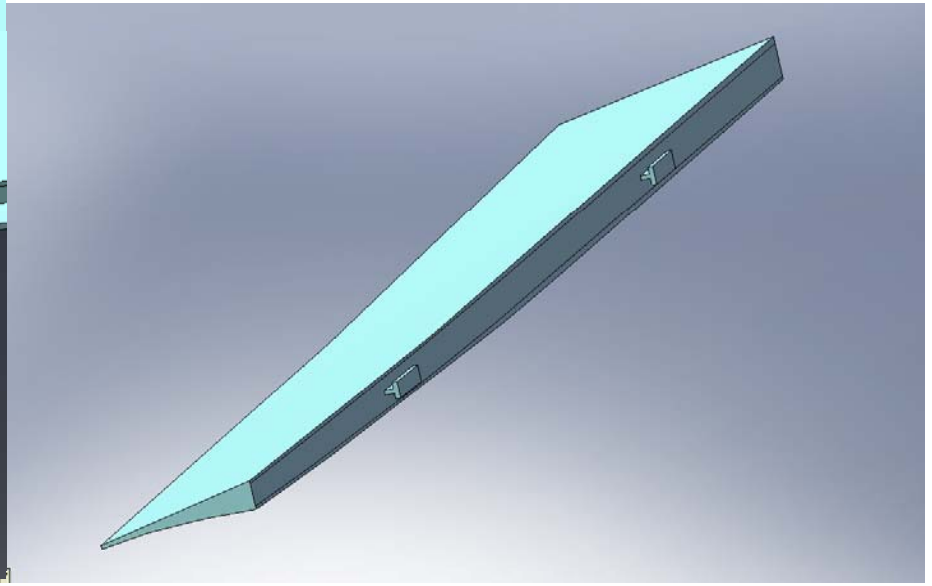
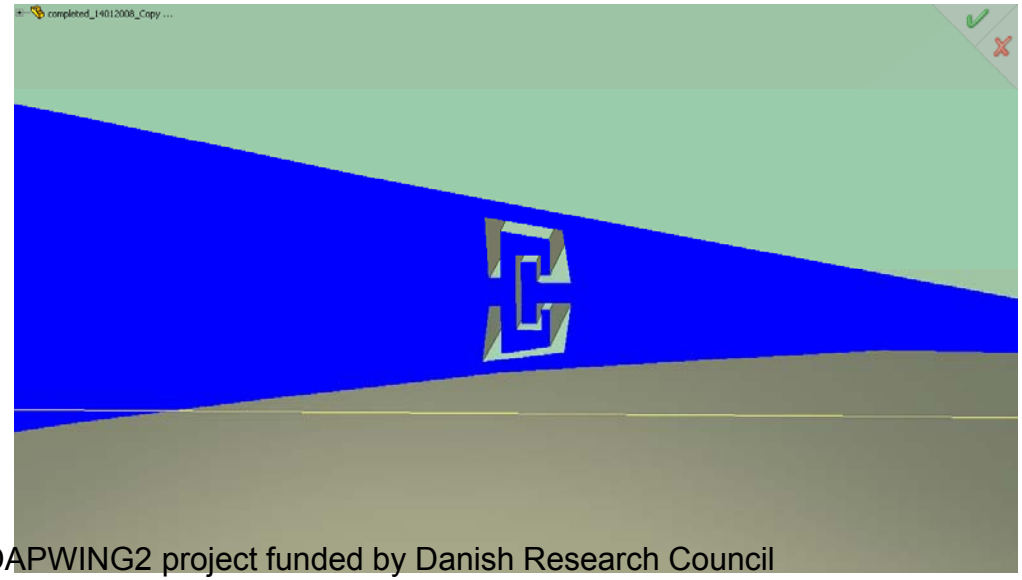
New concepts







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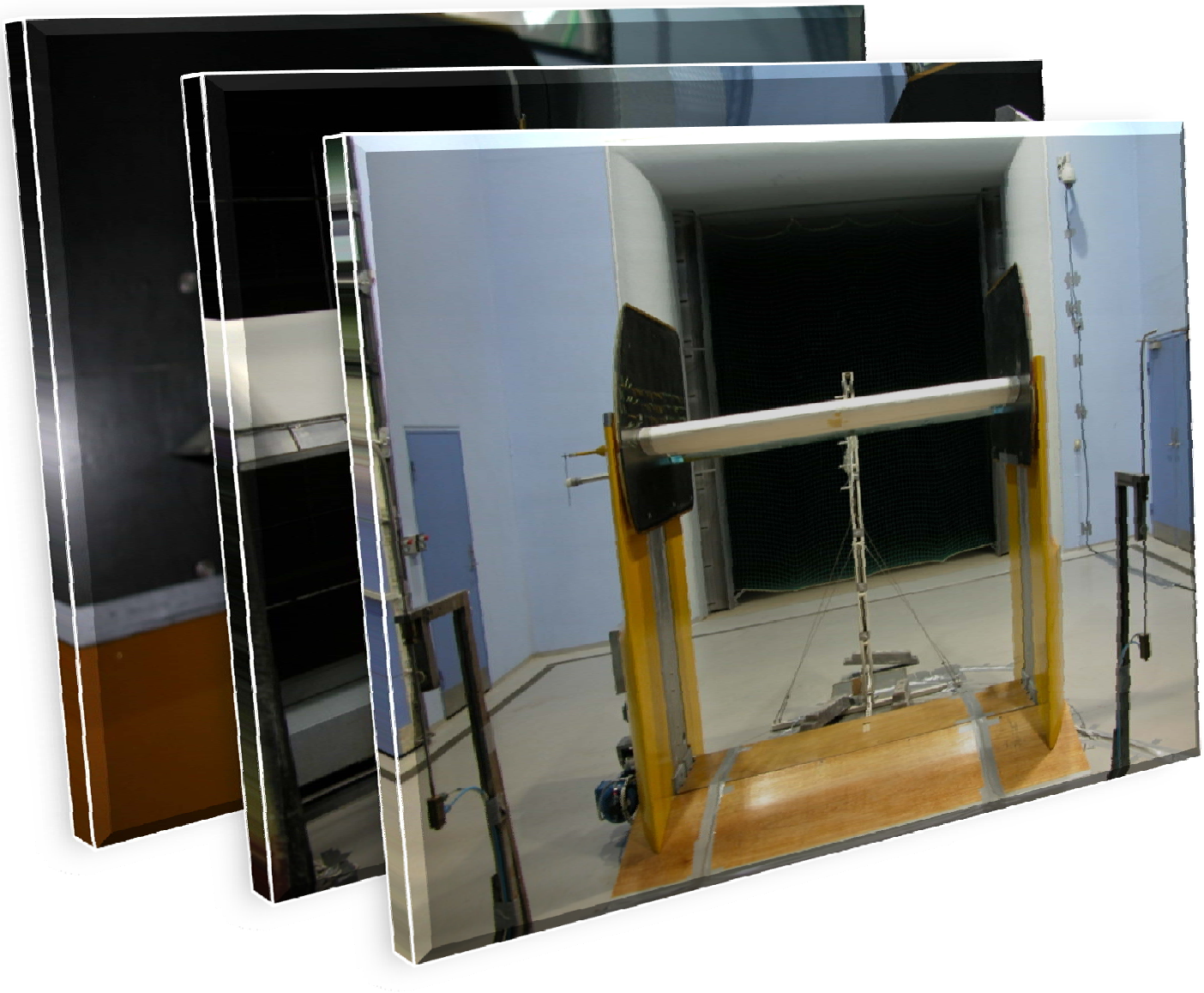
Wind tunnel tests

Wind tunnel tests

Wind tunnel tests



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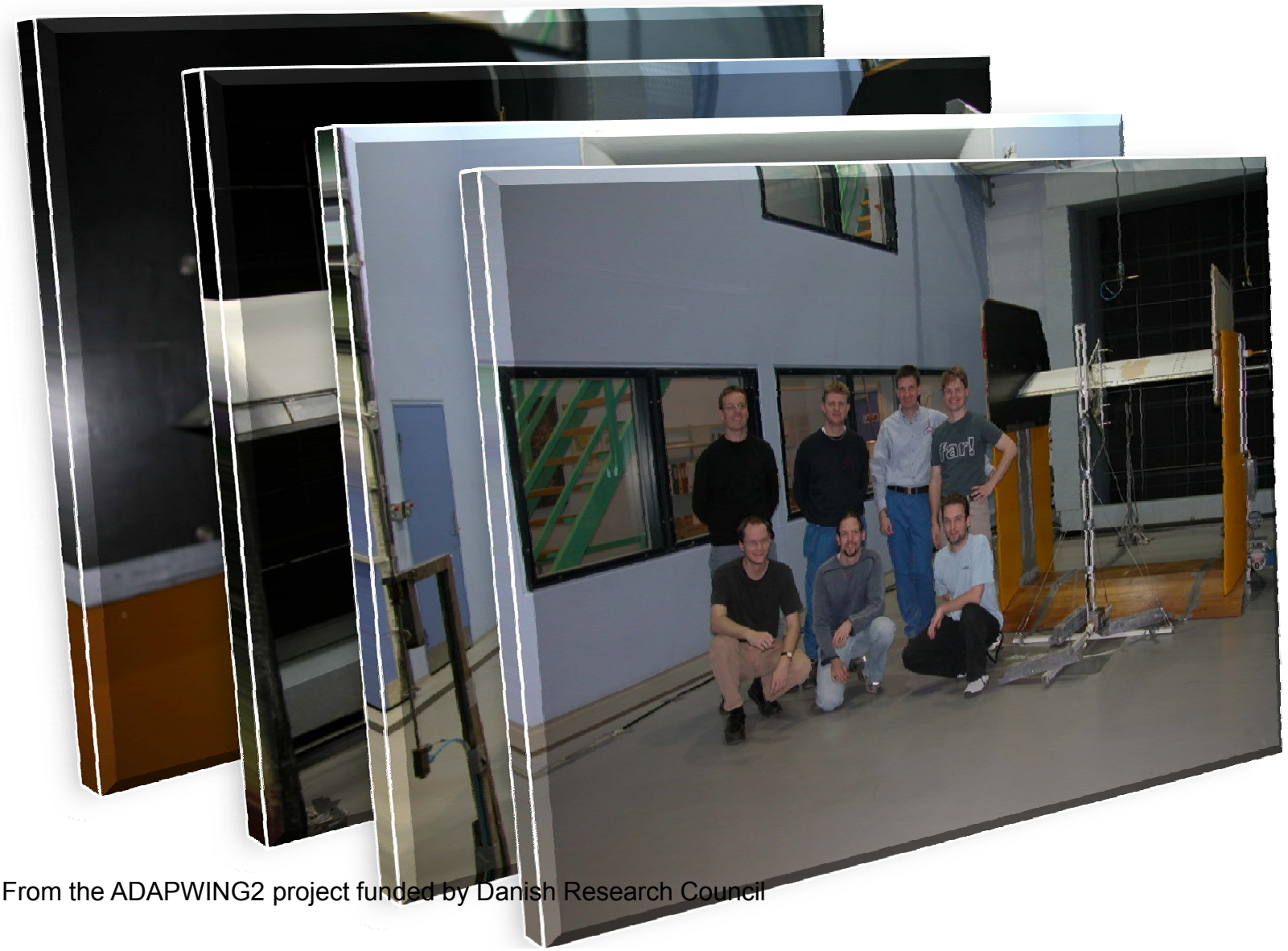

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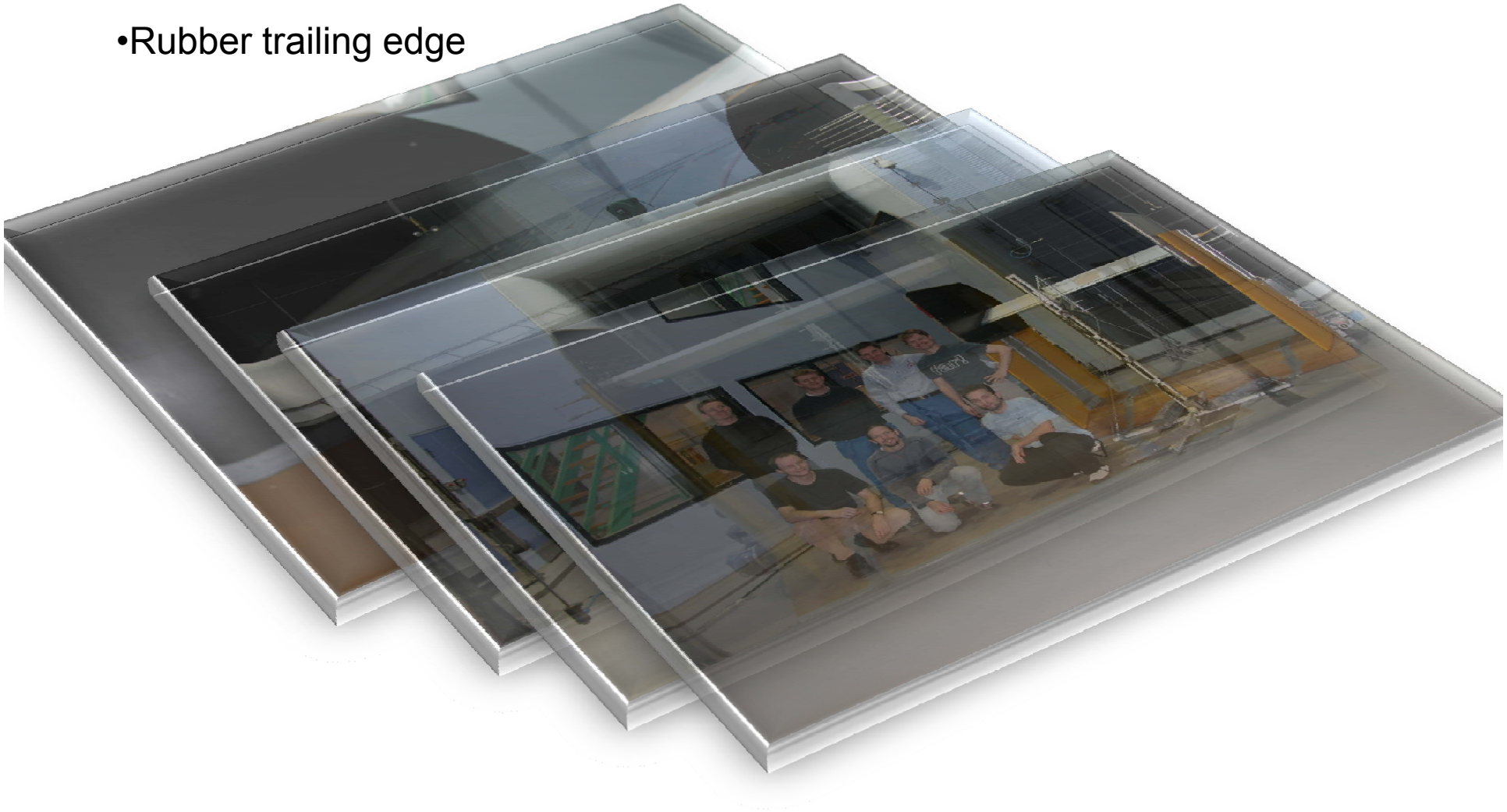
Wind tunnel tests

Planned for the near future:

- Close loop control
- Rubber trailing edge



Full scale tests

After summer 2008 full instrumentation of the test turbine V27

Beginning of 2009 measurement campaign for 3 month on the V27

May 2009 apply trailing edge flaps to existing blades

Summer 2009 measurement campaign with trailing edge flaps

Sensor design

Development of Pitot tubes:

Measurement campaign with Pitot tubes

Analysis of data

development of “new” Pitot tubes

Future work...

A “real” turbine

Acoustic noise reduction

Power production

Position of DTEG

Extreme directional change in wind direction

Dimension of DTEG

Main shaft (fatigue)

Extreme wind conditions (gusts)

Yaw misalignment

Tilting moment

Blade flapwise, extreme (bending, buckling)

Hardware in the loop

Offshore

Blade edgewise (fatigue)

Floating turbines

Yaw system (extreme)

Tower welding (fatigue)

Stand still

Main bearing (fatigue)

Negative wind shears

Lightning

CFD

Gear (fatigue)

Wind farm issues

Monte Carlo simulations

Sensor dynamics/hysteresis

IEC Load case

Pitch regulation

Sensor delay

Signal noise

Two bladed turbine

Stability

Foundation (extreme)

Emergency shut down